REMARKS

This is intended as a full and complete response to the Office Action dated December 7, 2010 having a shortened statutory period for response set to expire on March 7, 2011. Claims 6, 51, 55 and 65 have been amended and new claim 68 has been added to more clearly recite various aspects of the invention. Applicants believe no new matter has been introduced by the amendments and the new claim presented herein. The amendments and the new claim have been made in a good faith effort to advance prosecution on the merits. Please reconsider the claims pending in the application for reasons discussed below.

Claim 55 stands rejected under 35 U.S.C. 101 for being inoperative and lacking utility. Claim 55 has been amended according to the Examiner's suggestion to now include "current velocity" and "wind velocity." Support for the amendment may be found throughout the specification, including page 11, lines 1-3. Withdrawal of the rejection is respectfully requested.

Claims 1-3, 6, 9-15, 18, 19, 22, 25, 27, 28, 30, 39-46, 49, 51, 54, 55, 59, 63, 65 and 66 stand rejected under 35 U.S.C 103(a) as being unpatentable over U.S. Patent No. 6,691,038 ("Zajac") in view of U.S. Patent no. 6,590,831 ("Bennett"). Zajac is generally directed to an active control system for a towed seismic streamer array that enables relative positional control of towed seismic streamers. (See Zajac, Abstract). Bennett is generally directed to a system for coordinating the operation of multiple vessels engaged in marine seismic data acquisition. (See Bennett, Abstract). Claim 51 has been amended to now include "controlling the seismic survey spread by coordinating the positioning of the first vessel control element, the second vessel control element, the first source control element and the second source control element based on the estimated positions." Support for the amendment may be found throughout the specification, including page 45, lines 5-7.

The Examiner takes the position that Bennett teaches calculating drive commands for a seismic source control element and coordinating the positioning of source control elements in column 4, lines 20-58 and column 10, lines 60-65. (See Office Action, page 4, paragraph 8; page 10, paragraph 38; page 11, paragraph 41; and

page 13, paragraph 46). The relevant portions of Bennett are provided below for the Examiner's convenience.

> In one aspect of the present invention, a method and system are provided for **coordinating the operation of one or more marine vessels** engaged in seismic data acquisition comprising at least one vessel for performing one or more of deploying a source of acoustic energy for generating acoustic waves, deploying a receiver for receiving seismic data, and a processor for monitoring a parameter of interest of the received seismic data and **generating control commands for controlling the at least one vessel** in response thereto, the vessel further comprising a position sensor for determining a position of at least one vessel, the source of acoustic energy, the seismic receiver, and a **vessel maneuvering system** comprising a receiver for receipt of **vessel control commands**, a processor **interpreting vessel control commands**, and an output for executing **vessel control commands**. An environmental sensor is provided for monitoring and transmitting environmental data to the processor.
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> The processor receives position, environmental and operation data and sends a **vessel control command to the vessel maneuvering system**. Vessel maneuvering includes changes in heading, speed or depth of operation. The environmental data comprises at least one of: wind speed, wind direction, wave height, wave direction, wave period, tidal stream, ocean current, or water depth. A coverage optimization system wherein the coverage optimization system receives seismic coverage information, and sends optimum seismic source and seismic receiver positions to the vehicle management system. The VMS sends commands to the steering system. A binning system provides seismic coverage data to the coverage optimization system. The coverage optimization system receives operator data, position data and environmental data. The position sensor monitors seismic source position, seismic receiver position, vessel position, vessel ground speed, water speed, vessel track, and vessel heading. An operator console for operator data input wherein the operator data comprises prospect coverage area definition, required midpoint coverage, operational constraints, vessel performance data, or operator control.
> (Bennett, column 4, lines 22-58, Emphasis Added).
>
> As the COS (coverage optimization system) coverage optimization routing digests the prediction data; and determines the most efficient pass, the COS formulates requests for changes to position of seismic assets which are evaluated by the VMS (vessel maneuvering system) and if achievable without compromise to the safety of assets and personnel, **formulates commands for the vessel maneuvering system(s) 280 on each cooperating vessel 200**. These **vessel control commands** comprise directions to steer, speed through the water, turning radius and

sensor/receiver position commands **to control the position of towed seismic sources** and receivers.
(Bennett, column 10, lines 55-65, Emphasis Added).

As shown above, Bennett does not teach calculating drive commands for a seismic source control element and a streamer control element, as recited in claims 1 and 25. In contrast, Bennett teaches issuing vessel control commands to a vessel to control the position of a source, which is not the same as using a source control element and a streamer control element to control the position of a source. New claim 68 has been added to further clarify source control elements. New claim 68 describes a source control element as being coupled between a seismic source and a vessel. Support for the new claims may be found throughout the specification, including page 14, line 25 to page 15, line 3 and Figure 1, item #17. Bennett does not teach a source control element that is coupled between a vessel and a seismic source. Rather, Bennett only mentions using a vessel to control towed objects and never mentions source control elements anywhere in its disclosure.

Further, as shown above, Bennett does not teach coordinating the positioning of source control elements, as recited in claims 45, 49 and 59. In contrast, Bennett only coordinates the operation of one or more marine vessels. Coordinating the operation of vessels is not the same as coordinating the operation of source control elements.

Additionally, with regard to claims 45, 49, 51 and 59, the Examiner takes the position that Bennett teaches wherein the spread control elements comprise source control elements in column 10, lines 60-65. (See Office Action, page 7, paragraphs 22-23; page 10, paragraphs 37-38; page 11; paragraphs 40-41; and page 13; paragraph 46). As shown in the reproduced section above, Bennett does not teach spread control elements that include source control elements. In contrast, Bennett's spread control elements only include vessels. A vessel, however, is not a source control element.

Claim 6 has been amended to now include "wherein the predicted residuals are used to estimate error states associated with one or more sensors that measure the environmental data." Support for the amendment may be found throughout the specification, including page 9, lines 1-2. Zajac does not teach this limitation.

With regard to claim 6, the Examiner takes the position that Zajac teaches using predicted residuals to estimate error states associated with measurements of the environmental data in column 5, lines 19-20 and column 10, lines 56-64. (See Office Action, page 5, paragraph 11). The relevant portions of Zajac are reproduced below for the Examiner's convenience.

> In another aspect of the invention the apparatus further comprises a monitor for determining the status of each streamer, wherein the master controller adjusts the array geometry to compensate for a failed streamer.
> (Zajac, column 5, lines 18-22)
>
> Thus, the present invention senses a failed streamer cable in an array geometry and adjusts the position of adjacent streamer cables so that the beam pattern of the sensing array covers the area covered by the failed streamer. The compensation for a failed array streamer and associated compensation array geometry are noted and stored by the present invention so that post processing analysis compensates for variations in the data caused by the compensation array geometry.
> (Zajac, column 10, lines 56-64)

As shown above, Zajac does not teach error states associated with sensors that measure environmental data, as recited in claim 4. In contrast, Zajac senses whether a streamer cable has failed. A streamer cable is not the same as a sensor that measures environmental data.

With regard to claim 65, the Examiner takes the position that Zajac teaches operating states from sensors that measure water flow rate in column 9, lines 34-36. (See Office Action, page 14, paragraph 49). Claim 65 has been amended such that the "water flow rate" has been removed from the claim. As such, claim 65 now recites "wherein the sensors measure tension, vertical inclination, body orientation, acceleration or combinations thereof associated with the spread control elements." Accordingly, since claim 65 no longer recites water flow rate, Zajac does not teach all the limitations recited in claim 65.

For these reasons, claims 1, 6, 25, 45, 49, 51, 59 and 65 are patentable over Zajac and Bennett. Claims 2-3, 9-15, 18, 19, 22, 27, 28, 30, 39-44, 46, 54, 55, 63 and 66 are also patentable over Zajac, since they depend from claims 1, 25, 45, 49, 51 and 59, respectively. Withdrawal of the rejection is respectfully requested.

Claims 4, 5, 7, 16 and 53 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zajac in view of Bennett and further in view of US Patent No. 6,618,321 ("Brunet"). Claim 8 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Zajac in view of Bennett and further in view of US Patent No. 5,448,233 ("Saban"). Claims 17 and 23 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zajac in view of Bennett and further in view of US Patent No. 7,446,706 ("Riley"). Claim 20 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Zajac in view of Bennett and further in view of Gikas et al, "Reliability analysis in dynamic systems: Implications for positioning marine seismic networks", *Geophysics*, Vol. 64, No. 4, July-August 1999, pgs. 1014-1022 ("Gikas"). Neither Zajac nor Bennett nor Brunet nor Saban nor Riley nor Gikas, alone or in combination, teaches or discloses calculating drive commands for a seismic source control element, as recited in claims 1 and 23. Since claims 4, 5, 7, 8, 16-17, 20 and 53 depend from claim 1 and since neither Zajac nor Bennett nor Brunet nor Saban nor Riley nor Gikas, alone or in combination, teaches, discloses or suggests all the limitations of claim 1, claims 4, 5, 7, 8, 16-17, 20 and 53 are therefore also patentable over Zajac, Bennett, Brunet, Saban, Riley and Gikas. Withdrawal of the rejection is respectfully requested.

Claims 21, 26 and 31 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zajac in view of Armstrong et al, "The best parameter subset using the Chebychev curve fitting criterion", *Mathematical Programming*, Vol. 27, No. 1, September 1983, pgs. 64-74 ("Armstrong"). US Patent No. 6,292,436 ("Rau") and US Patent No. 6,681,710 ("Semb"), respectively. Applicants believe that the Examiner intended to reject these claims further in view of Bennett as well because the Examiner refers to Bennett in the rejection to these claims. As such, Applicants assume that the rejection to claims 21, 26 and 31 were made in view of Bennett as well.

Neither Zajac nor Bennett nor Armstrong nor Rau nor Semb, alone or in combination, teaches or discloses calculating drive commands for a seismic source control element, as recited in claims 1 and 25. Since claims 21, 26 and 31 depend from claims 1 and 25 and since neither Zajac nor Bennett nor Armstrong nor Rau nor Semb, alone or in combination, teaches, discloses or suggests all the limitations of claims 1

and 25, claims 21, 26 and 31 are therefore also patentable over Zajac, Bennett, Armstrong, Rau and Semb. Withdrawal of the rejection is respectfully requested.

Claims 32-37 and 61 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zajac in view of US Patent No. 6,088,298 ("Onat"). Applicants believe that the Examiner intended to reject these claims further in view of Bennett as well because as well because the Examiner refers to Bennett in the rejection to these claims. As such, Applicants assume that the rejection to claims 32-37 and 61 were made in view of Bennett as well.

Onat is generally directed at activating one of a plurality of subsets of transducer elements that is defined by a pattern throughout an array of activated members of the elements and non-activated members of the elements. (See Onat, Abstract). With regard to claims 32 and 37, the Examiner takes the position that Onat teaches activating only a selected portion of the sources that are at the proximities of the desired crossline positions in column 2, lines 55-56 and lines 61-63. (See Office Action, page 21, paragraph 79). In addition to the Examiner's cited portion of Onat, column1, lines 13-16 of Onat is provided below to place Onat in its proper context.

> The present invention **relates generally to sonar arrays**, and more particularly to modifying or setting the operational center frequency of an array by selective **activation of transducer elements** in the array.
> (Onat, column 1, lines 13-16, Emphasis Added).
>
> Referring now to the drawings, and more particularly to FIG. 1, a first embodiment of the present invention will be described where a two-dimensional M×N array 10 of **square transducer elements 12** is shown. For simplicity of illustration, each of elements 12 is shown touching neighboring elements. However, as is known in the art, each of elements 12 are slightly spaced from neighboring elements by an amount dependent on the particular application. This particular intra spacing is not a factor in the present invention. The row and column intra spacing between centers of neighboring elements is d. Each element's identity in array 10 is denoted by E_{MN} where M is a row number and N is a column number. Electrically coupled to each element 12 is a controller 14 for activating and deactivating selected members of elements 12 as controlled by either an operator input 16 or a programmed instruction set 18 coupled to controller 14.
>
> In operation of the device of the present invention, controller 14 **activates a pattern of activated members of elements 12 viewed or**

> **beamformed in a particular direction**. The pattern and its beamforming direction sets the operational center frequency of array 10. The activated set of elements 12 have a uniform on-center spacing between adjacent activated elements in the beamforming direction throughout the array. In FIG. 1, controller 14 **activates members of elements 12 (indicated by stippling) along the diagonal staves of array 10**. A stave is defined as contiguous elements in a line such as a diagonal of array 10.
> (Onat, column 2, lines 54-64, Emphasis Added).

As shown above, Onat does not teach activating a selected portion of the sources, as recited in claims 32 and 37. In contrast, Onat teaches activating a pattern of transducer elements in order to modify or set the operational center frequency of sonar arrays. (See Onat, column 1, lines 13-16). Transducer elements, however, are not the same as seismic sources. In fact, Onat never mentions seismic sources anywhere in its disclosure.

Further, Onat does not teach activating sources when the selected portion **is within a vicinity of desired cross line positions**. In contrast, Onat activates its transducer elements that are viewed or beamformed in a particular direction or along diagonal staves of the transducer array. In this manner, Onat is not concerned with when the selected portion of sources is within a vicinity of desired cross line positions. In fact, Onat never mentions a desired cross line position anywhere in its disclosure.

With regard to claim 61, the Examiner takes the position that Zajac teaches steering the selected portion within a cross line corridor to the vicinity near the desired cross line positions in column 8, lines 1-38. (See Office Action, page 23, paragraph 89). The relevant portion of Zajac is provided below for the Examiner's convenience.

> The array, streamer and individual ASPD three-component (x, y, z) position data with respect to time is stored along with real time environmental data. Environmental data is received via cable or radio from sensors deployed from the vessel or the array. The stored position and environmental data is stored as legacy data in the legacy data storage 22. Optimal path data, is generated by Optimal path processor 24, which may be generated by a neural network or some other methodology such as human input or mathematical formulae, is input to master controller 26. Optimal path data may be provided as a desired seismic acquisition path during primary seismic data acquisition or during in fill shooting. Optimal path data steering is preferably divided between an optimal path for the tow vessel 10 and an optimal path for the towed array. During seismic

> data acquisition utilizing an optimal path 24, vessel, array, array element and ASPD positions are sensed along with environmental data are transmitted to and received by the data acquisition unit 21. The data acquisition unit 21 stores these inputs with respect to time as legacy data in the legacy data storage 22. The data acquisition unit 21 also passes the array and environmental tracking data to the master controller 26. The maneuverability of the particular cable, ASPD and vessel under the particular sensed environmental conditions are also factored into the active positioning commands. For example, a cable that becomes stiffer in colder water or more buoyant in higher salinity receives an augmented steering command depending on the sensed environmental data. Master controller 26 compares the current vessel and array position data with the desired position or optimal vessel and array path position. The master controller 26 then determines, in light of the current environmental conditions and the maneuverability of the vessel, ASPDs and towed streamers comprising the array, the timing and magnitude of positioning commands to be sent to the ASPDs on the array. The positioning commands are formatted and transmitted by active position commander 28 over link 30. Link 30 may be hardwired or wireless via satellite, laser or radio link.
> (Zajac, column 8, lines 1-38).

As shown above, Zajac does not teach steering the selected portion within a cross line corridor to the vicinity near the desired cross line positions, as recited in claim 61. In contrast, the above portion of Zajac teaches sending commands to ASPDs in light of current environmental conditions and the maneuverability of the vessel, ASPDs and towed streamers comprising the array. Zajac's commands sent to ASPDs do not steer a portion of its sources within a cross line corridor to a vicinity near the desired cross line positions.

For these reasons, claims 32, 37 and 61 are patentable over Zajac, Bennett and Onat. Claims 33-36 are also patentable over Zajac, Bennett and Onat since they depend from claim 32. Withdrawal of the rejection is respectfully requested.

Claims 47, 62 and 64 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zajac in view of Bennett and further in view of US Patent Application No. 2005/0180263 ("Lambert"). The Examiner takes the position that Lambert teaches estimating one or more positions of the spread components based on data received from acoustic positioning receivers and references on the seismic survey with respect to earth. (See Office Action, paragraph 92). However, like Zajac and Bennett, Lambert

also does not teach “coordinating the positioning of the vessel control elements, the source control elements and the streamer control elements,” as recited in claim 45; “coordinating the positioning of vessel control elements and source control elements,” as recited in claim 47; and “coordinating the positioning of the streamer control elements and the source control elements,” as recited in claim 49. Claim 47 is therefore patentable over Zajac, Bennett and Lambert. Since claims 62 and 64 depend from claims 45 and 49 and since neither Zajac nor Bennett nor Lambert, alone or in combination, teaches, discloses or suggests all the limitations of claims 45 and 49, claims 62 and 64 are therefore also patentable over Zajac, Bennett and Lambert.

Claims 56-58 and 67 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zajac in view of Bennett in view of Onat and further in view of Lambert. Neither Zajac nor Bennett nor Onat nor Lambert, alone or in combination, teaches or discloses activating only a selected portion of the sources that are at the proximities of the desired crossline positions, as recited in claim 32. Since claims 56-58 and 67 depend from claim 32 and since neither Zajac nor Bennett nor Onat nor Lambert, alone or in combination, teaches, discloses or suggests all the limitations of claim 32, claims 56-58 are therefore also patentable over Zajac, Bennett and Lambert.

Claim 60 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Zajac in view of Bennett and further in view of U.S. Patent No. 7,047,989 (“Petersen”). Applicants believe that the Examiner intended to refer to U.S. Patent No. 7,047,898 (“Petersen”) because the ‘989 patent is not related to seismic streamers nor does it include an inventor named Petersen. Therefore, the following response is made assuming that the Examiner rejected claim 60 under 35 U.S.C. § 103(a) as being unpatentable over Zajac in view of Bennett and further in view U.S. Patent No. 7,047,898 (“Petersen”).

Neither Zajac nor Bennett nor Petersen, alone or in combination, teaches or discloses coordinating the positioning of source control elements or a spread control element that is a source control element, as recited in claim 59. Since claim 60 depends from claim 59 and since neither Zajac nor Bennett nor Petersen, alone or in combination, teaches, discloses or suggests all the limitations of claim 59, claim 60 is

therefore also patentable over Zajac, Bennett and Petersen. Withdrawal of the rejection is respectfully requested.

In conclusion, the references cited by the Examiner, neither alone nor in combination, teach, show, or suggest the claimed invention. Having addressed all issues set out in the office action, Applicants respectfully submit that the claims are in condition for allowance and respectfully request that the claims be allowed.

The prior art made of record is noted. However, it is believed that the secondary references are no more pertinent to the Applicants' disclosure than the primary references cited in the office action. Therefore, it is believed that a detailed discussion of the secondary references is not deemed necessary for a full and complete response to this office action.

Respectfully submitted,

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